The Icy Climate of Mars

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**Description:**

- Develop and use global models of the martian climate, acquiring valuable skills in numerical modelling, climate and planetary science.
- Investigate the origin and stability of glaciers seen on Mars.
- Work in collaboration with an active space mission team, with access to the latest images.

There is abundant evidence of water ice on the surface and in the subsurface of Mars, mainly at mid- and high-latitudes [e.g. 1]. This includes not only the polar caps, and morning ground frosts, but the remnants of mid-latitude glaciers. Water ice clouds are also common at low latitudes, throughout the northern hemisphere summer in particular. In the present day, however, liquid water is not stable at the martian surface, except under unusual conditions. It is known that Mars has undergone very large variations in its orbit in the past [2] and it has been suggested that these might be linked to deposits of ice through changes in climate. It is also likely that mid-latitude glaciers accumulated under different climate conditions. This project seeks to develop a fast Mars global climate model (MGCM) that can be used to explore the change in water ice at the surface of Mars over long periods of time, up to several hundred million years in the past, and attempt to link regions of accumulation or loss of water ice to recent observations of features on the martian surface.

![Figure 1](image)

*Figure 1* The water vapour distribution in an MGCM simulation (150 km resolution at the equator) and a mesoscale simulation (4 km resolution). Black contours show MGCM topography.

Present day water fluxes can be computed using our existing MGCM [3]. Together with a related, limited-area mesoscale model, we are able to retrieve information on the accumulation or loss of water ice at the surface at targeted areas in high resolution (Figure 1).
One disadvantage of these models is that they require very large amounts of computer time. This project will attempt to formulate a new MGCM, with a dynamical core based on the community “Isca” model framework [4] and a simplified set of physical sub-models, intended to be run more quickly on small computer clusters. The new MGCM will be run over a range of orbital parameters to simulate periods during the past few hundred million years of Mars’ history.

The supervisors are all on the science teams for the Nadir and Occultation for MArS Discovery (NOMAD) instrument or the Colour and Stereo Surface Imaging System (CaSSIS) aboard ESA ExoMars Trace Gas Orbiter. This ensures that the latest observations will be readily available to the project.

References:


Qualifications required:

Suitable for graduates with a physics, mathematics or related numerate undergraduate degree, particularly those with an interest in numerical modelling. Some knowledge of atmospheric science, such as a relevant course within an M.Phys. or M.Sc. would be helpful, but not essential.